

JAGUAR CONSERVATION ASSESSMENT AND FRAMEWORK FOR ARIZONA, NEW MEXICO, AND NORTHERN MEXICO

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and
New Mexico Department of Game and Fish

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1. Introduction

The jaguar (*Panthera onca*) is the largest species of cat native to the Western Hemisphere and the third largest cat in the world. It is listed under the Endangered Species Act (ESA) of 1973 as endangered throughout its range, from the southern United States (i.e. the states bordering Mexico) southward through South America. There is no evidence of a breeding population here, but several reports since 1996 have been confirmed of individuals along the U.S./Mexico border in southern Arizona and New Mexico. The most recent confirmed photograph was in May 2006. Presence of this species in the United States currently depends on movement from northern Mexico (USFWS 1997).

In 1996, two mountain lion hunters documented jaguar presence in the United States through photographs. The first hunter, Warner Glenn, was in the Peloncillo Mountains along the Arizona/New Mexico border in March, and the second, Jack Childs, was in the Baboquivari Mountains in southern Arizona in August (see Glenn 1996, Childs 1998). These sightings stimulated development of a Jaguar Conservation Agreement in 1997 to conserve the species in Arizona and New Mexico through voluntary collaborative conservation efforts and preclude the need to list the species federally north of the U.S.-Mexico border (Johnson and Van Pelt 1997). The encounters prompted both men (and their families) to become directly involved and influential in the conservation effort (Childs 2004).

The *Conservation Assessment and Strategy for the Jaguar in Arizona and New Mexico* (Johnson and Van Pelt 1997) described the current status of the jaguar in the United States and identified and assessed risks in Arizona and New Mexico. The conservation strategy portion described goals, objectives, strategies, and activities intended to conserve jaguars in Arizona and New Mexico. The strategy also recognized the need to encourage and support parallel conservation efforts in northern Mexico.

In addition, a Memorandum of Agreement (MOA) for jaguar conservation in Arizona and New Mexico was developed and signed by various state, federal, and local agencies in 1997. A key component was establishing a Jaguar Conservation Team (JAGCT) to direct conservation measures in the conservation strategy. Although the conservation effort ultimately did not preclude the need to list the jaguar, the U.S. Fish and Wildlife Service (USFWS) stated in its final listing rule that the Conservation Agreement would serve as a template for protections necessary for conservation of the jaguar (USFWS 1997).

JAGCT has met regularly (twice or more yearly) since 1996, and has produced three assessment reports documenting its progress (Van Pelt and Johnson 1998; Johnson and Van Pelt 2000; O'Neill and Van Pelt 2006). Various committees have been formed and assigned specific tasks to complete. While JAGCT remains the focal point of jaguar conservation in the United States, its activities have helped spur desired companion efforts in northern Mexico. Over the past several years, considerable progress has been made in Mexico, although much more is needed to adequately protect jaguar populations in Mexico, thus ensuring progress toward recovery and natural dispersal of animals to sustain peripheral occurrence. Specifically, conservation is needed for a known and potentially significant population of jaguars approximately 140 miles south of the U.S.-Mexico border. According to Brown and Lopez-Gonzalez (2001), as was recognized by

JAGCT in 1997, the fate of the borderlands jaguar depends largely on northern Mexico. The best available science suggests that, now and for the foreseeable future, dispersal from northern Mexico will be required to maintain jaguar presence in Arizona and New Mexico.

Although the jaguar is federally listed as endangered, USFWS is not developing a recovery plan at this time, because:

- (1) There is no known breeding population in the United States. All jaguars identified here since the 1960s have been males. USFWS gives priority to developing recovery plans for species with known breeding populations in the United States.
- (2) The vast majority of the jaguar's geographic distribution occurs south of the United States, and recovery must occur within that core range. However, a Conservation Framework for the northern portion of the range will contribute to the overall jaguar conservation effort.
- (3) USFWS believes that more conservation benefit can be gained through existing, voluntary conservation approaches, like JAGCT, and by fostering incentive-based approaches to conservation.

Thus, this Conservation Assessment and Framework has been developed to summarize conservation efforts in place for the jaguar in Arizona and New Mexico, to focus attention on needed jaguar conservation efforts in the United States and Mexico, and to help ensure connectivity and movement across the International Border. It also identifies information gaps that must be addressed to implement long-term management strategies to facilitate presence of jaguars in the United States and help ensure persistence here and in Mexico.

This Framework is intended to build on the foundation laid down by the 1997 Jaguar Conservation Strategy and to help guide future work on behalf of the northern jaguar population. It was developed by the Arizona Game and Fish Department (AGFD) and the New Mexico Department of Game and Fish (NMDGF), with assistance from USFWS and other signatory members of JAGCT and voluntary participants (i.e. the public).

For purposes of this document, the geographic range of the northern jaguar population primarily includes the Sierra Madre Mountains along the eastern boundary of the state of Sonora, Mexico, and extends into the state of Chihuahua, Mexico, south to the Alamos area and back north, staying primarily east and north of Mexican Highways 2 and 15. Individual jaguars occurring in Arizona and New Mexico are considered members of the northern jaguar population.

2. Species Status

2.1 Description

The jaguar is a member of the cat family (Felidae; genus *Panthera*) and is allied with the “roaring” cats. Recent phylogenetic relationships among felid species show jaguars genetically related to the African lion (*P. leo*), leopard (*P. pardus*), tiger (*P. tigris*), snow leopard (*P. uncia*), and clouded leopard (*Neofelis nebulosa*) (Johnson et al. 2006).

Jaguars are easily identified by their distinctive spotted coat, which has small dots or irregular shapes within larger rosette markings. The spotted rosette pattern might act as camouflage (see Brown and Lopez-Gonzalez 2001:19). No two jaguars have the same coloration or are marked exactly alike (Brown and Lopez-Gonzalez 2001), thus, coloration patterns can be used to identify individuals. Jaguars and mountain lions are among the few species of wild cats that have melanistic (black) individuals. Black jaguars are common in parts of the Americas (primarily southern South America) and are often referred to as “black panthers.” However, no black jaguars have been documented in the northern Mexico population (including the United States).

The largest species of cat native to North America, jaguars measure five to eight feet from nose to tail and weigh 140 to 300 pounds (Seymour 1989). Typically, females are slightly smaller than males (Emmons 1999).

2.2 Taxonomy

Five subspecies of jaguar were recognized by Hall (1981) and eight by Pocock (1939) and Seymour (1989)¹, including two with historical ranges extending into the United States (the Arizona jaguar, *Panthera onca arizonensis*; and the northeastern jaguar, *P. o. veraecrucis*). Records from Arizona, New Mexico, and California are attributed to *arizonensis*, the type specimen of which was collected in 1924, near Cibique, Navajo County, Arizona (Goldman 1932). Nelson and Goldman (1933) described the distribution of *arizonensis* as the mountainous parts of eastern Arizona north to the Grand Canyon, southwestern New Mexico, northeastern Sonora, and perhaps southeastern California. Jaguar records for Texas, and perhaps Louisiana, have been attributed to *veraecrucis*. Nelson and Goldman (1933) described the distribution of *veraecrucis* as the Gulf slope of eastern and southeastern Mexico, from the coast region of Tabasco north through Vera Cruz and Tamaulipas to central Texas.

More recent work suggests that subspecies recognition is not warranted in jaguars. Larson (1997) re-evaluated the skull morphologies that led predecessors to descriptively assign jaguars to eight subspecies. She applied the same criteria (11 skull characters) and used modern statistical analysis (Multigroup Discriminant Analysis and univariate statistics) to evaluate 170 skulls of known origin. As with other large carnivores reassessed in similar manner during the 1980s and 1990s (e.g. wolves), the results indicated variation within the subspecies exceeded variation between the subspecies. Larson concluded that no subspecies recognition was warranted. Molecular genetics

¹*Panthera* is used herein as the genus for the jaguar, per Nowak (1999) and others. Various earlier publications, including some of those referenced herein, refer it to the genus *Felis*.

confirmed in 1999 that there were no subspecies (Johnson et al. 1999). Nowak (1999) reflected that conclusion in the Sixth Edition of *Walkers Mammals of the World*.

2.3 Population Status and Trends

The jaguar's population decline in the United States was concurrent with predator control associated with settlement of land and emergence of the cattle industry, especially in Arizona (Brown 1983, USFWS 1990). Hock (1955) and Lange (1960) summarized jaguar records from Arizona and New Mexico that were known up to that time. Between 1885 and 1959, the reports consisted of 45 jaguars killed, plus 6 sighted and 2 recorded by evidence such as tracks and/or droppings.

Through the 1980s, most jaguars seen in the United States were killed. Brown (1991) related that accumulation of all known records indicated a minimum of 64 jaguars killed in Arizona after 1900. When plotted at 10-year intervals, records of jaguars reported killed in Arizona and New Mexico between 1900 and 1980 demonstrated a decline characteristic of an over-exploited resident population (Brown 1983). Further, Nowak (1975) identified killing of jaguars for commercial sale of their furs as a factor in extermination of a substantial resident population in central Texas during the late 1800s.

The number of historical records indicates the jaguar was probably an uncommon resident in the United States, but evidence of breeding is scant. Although females have been reported, evidence of breeding north of Mexico is limited to 3 reports in Arizona: a reported kill of a female with 2 kittens near the Grand Canyon between 1885 and 1890 (Lange 1960), a reported kill of a female and her young at the head of Chevelon Creek in 1910 (Brown 1987 and Nowak 1975), and a newspaper report of a female killed and her 2 kittens captured in the Chiricahua Mountains in 1906 (Brown 1989).

Recent sightings (post-1960) in Arizona and New Mexico appear to be mostly, if not entirely, transient males from Mexico. Of 7 1960 to 2006 animals confirmed and identified to gender, only 1 was female. These animals most likely dispersed from a core breeding population of approximately 100 individuals, in central Sonora, Mexico, approximately 140 miles south of the International Border (C. Lopez-Gonzalez pers. comm.).

2.4 Distribution – Historical and Current

United States – The jaguar's historical range in the United States includes portions of Arizona, New Mexico, California, Louisiana, and Texas. Brown and Lopez-Gonzalez (2001) compiled the most comprehensive information on the northern population. They documented 58 jaguars killed or photographed in Arizona and New Mexico from 1900 to 2000. Jaguars were killed as far north as the Grand Canyon in Arizona and the Datil Mountains in New Mexico (Brown and Lopez-Gonzalez 2001). Hill (1942) cited a report from near Springer in northeastern New Mexico. Brown and Lopez-Gonzalez (2001) noted that every published jaguar distribution map includes portions of New Mexico and Arizona as part of the historical range. Although there is disagreement about the jaguar's historical status in Arizona-New Mexico (i.e. resident/breeding

or transient?), clearly its natural historical range included the southwestern United States (USFWS 1997, Swank and Teer 1989, Brown 1983, Davis 1982, Goldman 1932, Bailey 1905).

Goldman (1932) believed the jaguar was a regular, but not abundant, resident in southeastern Arizona. Hoffmeister (1986) considered it an uncommon resident in Arizona, concluding that reports between 1885 and 1965 indicated a small but resident population once occurred in southeastern Arizona. Rabinowitz (1997, 1999) suggested evidence does not support conclusions that a significant population, or habitat suitable for establishing a persistent population, exists in the United States. Brown (1983) suggested jaguars in Arizona range widely through a variety of vegetation types, from Sonoran desertscrub upward through subalpine conifer forest. Most of the Arizona records to date have been from Madrean evergreen-woodland, shrub-invaded semidesert grassland, and along rivers.

From 1990 through February 2006, four jaguars were documented and another four Class 2 sightings (probable occurrences) were recorded in the United States. In 1996, two separate houndsmen encountered and photographed jaguars. The first was Warner Glenn, who photographed a jaguar on March 7, 1996, in the Peloncillo Mountains, along the Arizona-New Mexico border (Glenn 1996). The Peloncillos run approximately north-south to the Mexican border, where they join the beginnings of the Sierra San Luis and other ranges that connect to the Sierra Madre Occidental. The second was Jack Childs, who photographed a treed jaguar on August 31, 1996, in the Baboquivari Mountains in southern Arizona (Childs 1998). Jaguars (including some repeat occurrences of specific individuals) have also been photographed by remote-sensing cameras along the Arizona-Mexico border, beginning in 2001 and as recently as May 2006 (J. Childs pers. comm.). In February 2006, another jaguar was observed and photographed in Hidalgo County, New Mexico (W. Glenn pers. comm.).

Northern Mexico - Swank and Teer (1989) described jaguar distribution in Mexico as a broad belt from central Mexico to Central America. The most northerly established populations reported by Mexican officials were in southern Sinaloa and southern Tamaulipas. Despite rumors to the contrary, Brown (1991) did not believe the jaguar was extirpated from northern Mexico. Although jaguars were considered relatively common in Sonora in the 1930s and 1940s, he cited a population about 800 miles south of the U.S.-Mexico border as the most northern officially reported. However, Brown (1991) suggested there might be more jaguars in Sonora than were officially reported. He mentioned reports of 2 jaguars killed in central Sonora around 1970, and discussed assertions by local Indians that male and female jaguars still occurred in the Sierra Bacatete, about 200 miles south of Arizona. Brown speculated that a reproducing population of jaguars in those mountains could be the source of individuals that travel northward through the Sierra Libre and Sierra Madera until they reach Arizona.

Brown and Lopez-Gonzalez (2001) summarized jaguars reportedly killed or captured in the Mexican states of Sonora and Chihuahua from 1900 to 2000. They also discussed an extant population in Sonora, and another in the rugged *barrancas* (canyons) connecting northern Sinaloa and Sonora. Other reports and photographs indicated jaguar populations in the Sierra Bacatete and adjoining lands in the Yaqui Indian area in southeastern Sonora. However, the most northern population reported by Brown and Lopez-Gonzalez (2001) was within a 50-mile radius of the towns of Huasabas and Sahuaripa, about 140 miles south of the U.S-Mexico border.

2.5 Habitat

Little is known about characteristics of habitat used by jaguars in the northern extent of their range. Jaguars are known from a variety of vegetation communities (Nowak 1991, Seymour 1989), including those found in the arid Southwest (Nowak 1994). Toward and at middle latitudes, they show a high affinity for lowland wet communities, typically swampy savannas or tropical rain forests. However, they also occur in upland vegetation communities in warmer regions of North and South America. Swank and Teer (1989) stated that jaguars prefer a warm, tropical climate, usually associated with water, and are only rarely found in extensive arid areas. However, jaguars occur in dry tropical forest in Jalisco (B. Miller pers. comm.), and were reported by local residents as recently as 1991 as being not unusual, and in fact, still hunted in the arid Sierra del Bacatete (Sonora, Mexico) (D.E. Brown and T.B. Johnson pers. comm.).

Knowledge of jaguar distribution and ecology suggests this species occupies or occasionally uses a variety of habitats at the northern edge of its range. This is typical of a wide-ranging “top carnivore,” which tends to have less finite habitat requirements than many species. Recently, several studies have helped refine general understanding of habitats that have been or might be used by jaguars in Arizona and New Mexico, including studies by the Sierra Institute Field Studies Program (2000), Hatten et al. (2002 and 2005), Menke and Hayes (2003), Boydston and Lopez-Gonzalez (2005), and Robinson and Bradley (2005).

Conclusions about the conservation importance of historical and current habitats in Arizona and New Mexico vary widely, depending on assumptions factored into the analyses, including reliability of historic records and their significance as a predictor of habitat quality and value, and use by jaguars. For example, Boydston and Lopez-Gonzalez (2005) described land cover types where jaguars occurred. Predicted jaguar occurrences were on average warmer, sunnier, and had older soils than the study area as a whole. However, jaguars were not predicted to occur on Sonora’s coast, even though one male was recorded there and (T.B. Johnson pers. comm.) jaguars occur in similar coastal habitats in northern South America.

A. Rabinowitz (pers. comm.) considers prey availability and abundance “the one overwhelming determinant of where big cats reside,” and cautions that “if you take this out of the equation [in describing jaguar habitat], then you are not looking at jaguar habitat or potential habitat. You are simply looking at land suitability characteristics for jaguars.” Rabinowitz (pers. comm.) added that concerns about prey base in the core area of the northern jaguar population (in Mexico) were sufficient warrant concern about the long-term viability of that population.

2.6 Pertinent Biological and Ecological Factors

The list of prey taken by jaguars range-wide includes more than 85 species (Seymour 1989). Known prey include peccaries (javelina), capybara, paca, armadillos, caimans, turtles, livestock, and various birds and fish. Although it is commonly thought that javelina and deer are mainstays in the diet of jaguars in the U.S.-Mexico borderlands, other available prey, including livestock, are probably taken as well.

Similar to most large carnivores, jaguars have relatively large home ranges. According to Brown and Lopez-Gonzalez (2001), the home ranges of jaguars are highly variable and depend on topography, available prey, and population dynamics. However, little information is available on this subject outside tropical America, where several studies of jaguar ecology have been conducted. Quigley and Crawshaw (1992) estimated a minimum of 772 to 1160 mi² is needed to support 30 to 50 adult jaguars; the actual area depends upon prey density, habitat composition, and the amount of human exploitation. Individual jaguar home ranges vary from 11 to 16 mi² in Belize (Rabinowitz and Nottingham 1986) and from 10 to 20 mi² in Jalisco, Mexico (B. Miller pers. comm.). In Jalisco, home ranges tend to be smaller in the dry season than in the wet season, and females with young kittens tend to have smaller home ranges than those with older kittens (B. Miller pers. comm.). However, B. Miller (pers. comm.) noted that individuals recorded at the same location on consecutive days actually traveled as much as nine miles overnight before returning to that location. The average home range of radio-collared male jaguars in Venezuela was calculated at 19 to 30 square miles (49 and 78 sq km) (Brown and Lopez-Gonzalez 2001:60).

A recent publication on sexual differentiation in distribution potential of northern jaguars modeled distributions of males and females (Boydston and Lopez-Gonzalez 2005). Their results indicated eastern Sonora appeared capable of supporting male and female jaguars, with potential range expansion into southeastern Arizona. New Mexico and Chihuahua had environmental characteristics primarily limited to the “male niche,” and thus might be areas into which males occasionally disperse. Boydston and Lopez-Gonzalez (2005) further suggested environmental requirements for females might be limiting distribution of northern jaguars.

There is little reason to think that jaguar distribution is static. Over the past 100 years, the climate in the Southwest has become warmer and drier. The effects and importance of climate change on historical and future jaguar distribution at the northern periphery of the range are unknown, but indirect effects (e.g. diminished prey base) might be important. In the more arid portions of the Southwest, effects on availability of surface water might also come into play.

Recently, Channell and Lomolino (2000) assessed the importance of populations at the periphery of their range, in a study of dynamic biogeography and conservation of endangered species. In contrast to common opinions, their analysis suggests that populations persist longest at the extremes of their range, and accordingly such populations might deserve greater conservation focus than do “core” populations. It is an intriguing concept, and needs careful scrutiny to determine how, if at all, the findings relate to northern jaguar conservation.

2.7 Regulatory Mechanisms

Convention on International Trade in Endangered Species - The jaguar is listed under the Convention on International Trade in Endangered Species (CITES) as an Appendix 1 species. CITES prohibits international trade among member nations in Appendix 1 species, including trophies, skins, and products.

Mexico – Mexico’s federal government lists the jaguar as an endangered species throughout Mexico.

Endangered Species Act - The jaguar's federal status was changed administratively in 1972, when USFWS listed it as an endangered species, under the Endangered Species Conservation Act of 1969 (ESCA). Pursuant to ESCA, two lists of endangered wildlife were maintained: one for foreign species and one for species native to the United States. The jaguar appeared only on the List of Endangered Foreign Wildlife. In 1973, the ESA superseded the ESCA. The foreign and native lists were replaced by a single "List of Endangered and Threatened Wildlife" - September 26, 1975 - 40 FR 44412-44429). The jaguar was listed only in Mexico and Central and South America. On July 22, 1997, USFWS extended endangered status to the jaguar throughout its range, including the United States, under authority of the ESA (USFWS 1997).

State of Arizona - Jaguars are listed as nongame mammals under Commission Order 14, with no open season for legal take by hunting. Violation of this order is a Class 2 misdemeanor. In 1998, AGFD successfully advocated state legislation (Senate Bill 1106) imposing a \$2500 criminal penalty (Class 2 Misdemeanor) and up to \$72,500 in civil penalties for unlawful take of a jaguar. These fines are commensurate with current federal fines under the ESA. The state legislation was signed into law by Jane Hull, Governor of Arizona, on May 7, 1998, but only takes effect if the jaguar is removed from the federal endangered species list. The legislature's stated desire was to ensure that state penalties would not be additive to current federal penalties, and would serve as an inducement to federal delisting.

State of New Mexico - In 1999, during the 44th New Mexican Legislative Session, Senate Bill 252 was signed into law, establishing new regulations and penalties for illegally killing a jaguar. These would also take effect only if the jaguar is removed from the federal endangered species list. Although this law provided state penalties as high as those for any animal protected by the state of New Mexico, the penalties are not as high as those under the federal ESA. In the 2006 New Mexico legislative session, House Bill 536 ("Unlawful Trophy Animal Disposition") was passed and signed into law. It allows the New Mexico Game Commission to establish regulations authorizing higher civil damages than previously allowable for wildlife designated as trophy animals, and establishes a minimum \$2000 in civil penalties (without requiring removal from ESA listing to take effect). Thus, higher penalties for illegal jaguar killing may be established through Commission action.

3. Conservation Status

3.1 Threats

The Federal Register entry listing the jaguar as endangered (USFWS 1997) stipulated that, based on the best available information, the following actions (potentially perceived as threats) will not result in a violation of Section 9 (Prohibited Acts) of the ESA, provided these activities are carried out in accordance with any existing regulations and permit requirements:

- a. Normal ranching activities, except predator control targeting large cats that result in inadvertent trapping or mortality of a jaguar.
- b. Habitat clearing, except in areas where jaguars are known to exist or have been known to exist.
- c. Fencing or other property delineation.

- d. If, when using dogs, a jaguar is inadvertently chased and/or treed by the dogs, so long as the dogs are called off upon realization that a jaguar is being chased.

USFWS noted that take by any of the following activities would likely violate section 9 of ESA:

- 1) Any activity specifically prohibited by ESA (e.g. shooting, hunting, trapping, etc.)
- 2) Intentional clearing or destruction of habitat known to be occupied by jaguars.
- 3) Any activities that fall within the definition of harass and harm. USFWS defines the terms harass and harm as follows: Harass means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Harm has been defined as an act which actually kills or injures wildlife. Such acts may include significant habitat modifications or degradation when it actually kills or injures wildlife by significantly impairing essential behavioral patterns including breeding, feeding or sheltering.
- 4) Predator control activities targeting large cats that trap, kill, or otherwise injure jaguars.

According to the 1997 federal listing of the jaguar as endangered, the primary threat in the United States is illegal shooting. The most recent known killing of a jaguar in the United States was in 1986, in Arizona (Brown and Lopez-Gonzalez 2001). Although the demand for jaguar pelts apparently has diminished, it still exists, along with the business of illegal hunting of jaguars. Conflicts between ranchers and jaguars in Sonora also might still result in jaguar killings (Lopez-Gonzalez 2004).

Loss, fragmentation, and modification of jaguar habitat are also likely to have contributed to population declines throughout its range, including northern Mexico. Although the extant population in Sonora occurs in an extremely rugged area (Lopez-Gonzalez 2004), habitat loss or road development in this area is at least a potential threat. Urbanization, including subdivision and subsequent habitat fragmentation in rural areas, is prevalent in much of the United States and Mexico, and it is increasing.

Since September 11, 2001, it has become more likely that International Border issues such as lighting, fencing, road construction and maintenance, vehicle traffic, bridges, border surveillance and security activities, and habitat alteration to facilitate law enforcement might influence jaguar conservation. The North America Free Trade Agreement in 1994, increased border monitoring associated with illegal immigration starting in 1998, and homeland security activities since 2001 have impacted other endangered species (e.g. ocelot in Texas), and have the potential to impact current and future jaguar conservation efforts by limiting natural movement across the border (in either direction). For example, illegal immigration and homeland security operations are being pushed from traditional entry points into more inaccessible zones, where impacts on the jaguar and other species might be high (Ackerman 1998). Many of these areas traditionally had little human disturbance. With the drafting of the *Programmatic Environmental Impact Statement for US Border Patrol Activities within the Border Areas of the Tucson and Yuma Sectors, AZ* in October 2002 (Immigration and Naturalization Service 2002), border security actions will need

to be addressed as they relate to jaguar conservation and maintaining wildlife connectivity between the United States and Mexico.

Illegal immigration by foot or vehicle across the U.S.-Mexico border has itself become a significant problem in the area occupied or possibly occupied by jaguars. Drug trafficking and smuggling often appear to be strongly linked to illegal immigration. Collectively, the huge and apparently increasing numbers of border crossers are leaving behind literally tons of trash. Poaching of wildlife, particularly animals that are common prey of jaguars (e.g. deer and javelina), as subsistence food is widely evident. In many areas, loss of shrubs and undergrowth to make room for primitive camps and to fuel campfires has substantially changed the habitat. Perhaps as important is disruption of jaguar and prey movements due to the nocturnal nature of the human traffic, which tends to use areas with difficult access for enforcement officials. Some of these are the same areas in which jaguars have occurred recently.

3.2 Conservation Efforts and Research in the United States

Conservation efforts are ongoing for the jaguar; many are voluntary actions by non-governmental entities. Below, we summarize known conservation and research efforts being conducted on jaguars in the borderland region. Studies to assess the status and ecological needs of the jaguar within the borderlands region are also summarized.

Jaguar Conservation Team – In September 1996, AGFD, NMDGF, and Texas Parks and Wildlife Department began discussing a possible conservation agreement for jaguars. Texas soon dropped out of the effort, but AGFD and NMDGF finalized a *Conservation Assessment and Strategy for the Jaguar in Arizona and New Mexico*, on March 24, 1997 (Johnson and Van Pelt 1997). The document described the current status of the jaguar in the United States, and identified and assessed risks in Arizona and New Mexico. The conservation strategy portion of the document described goals, objectives, strategies, and activities intended to conserve jaguars in Arizona and New Mexico.

In 1997, the Jaguar Conservation Team (JAGCT) formed under the strategy held its first meeting, in Douglas, Arizona. JAGCT is composed of agencies signatory to a March 24, 1997 Memorandum of Agreement for the Conservation of the Jaguar in Arizona and New Mexico (hereafter MOA). It meets periodically to discuss recent jaguar sightings, management issues, education needs, and research efforts. Each MOA signatory agency has one voting representative on JAGCT. In accordance with the MOA, JAGCT established a Jaguar Working Group (JAGWG) to provide for direct public involvement in addressing specific jaguar conservation issues and reporting recommendations to JAGCT. JAGWG is thus comprised of an innovative group of ranchers, stakeholders, and state and federal representatives. Since 1997, JAGCT has established camera-monitoring in Arizona, identified habitats known to have been used by jaguars and/or potentially of use to jaguars, and developed a jaguar-centric teaching guide that meets both national and state education standards.

U.S. Fish and Wildlife Service - USFWS' (1990) Listed Cats of Texas and Arizona Recovery Plan (With Emphasis on the Ocelot) addresses the jaguar and jaguarundi, but primarily focuses

on the ocelot. The plan only provides limited information on the jaguar, stating that the status in northern Mexico needs to be determined before recovery recommendations can be made.

Malpai Borderlands Group - The Malpai Borderlands Group (MBG) consists of private landowners living in the borderlands of southeastern Arizona and southwestern New Mexico, near the U.S.-Mexico border. These borderlands total approximately one million acres and include approximately 30 privately-owned ranches, as well as a mosaic of state and public lands. MBG's goal is to restore and maintain the natural processes that create and protect a healthy, unfragmented landscape, to support a diverse, flourishing community of human, plant, and animal life. After Warner Glenn's 1996 sighting and photographs of the jaguar in the Peloncillo Mountains, MBG met with AGFD and NMDGF and the Bureau of Land Management, Forest Service, and USFWS to discuss the sighting's implications. As a result, MBG established a fund to help compensate ranchers for livestock killed by jaguars. A portion of the proceeds from the book, *Eyes of Fire: Encounter with a Borderlands Jaguar* (Glenn 1996), in which Warner Glenn described his 1996 jaguar sighting in the Peloncillo mountains, is donated to the Jaguar Fund.

Northern Jaguar Project - The Northern Jaguar Project, Inc., a non-profit organization based in Tucson, Arizona, is dedicated to conservation of jaguar habitat in Sonora and creation of a safe-haven corridor between the Sonoran breeding population and the United States/Mexico borderlands. The Project promotes conservation ranching and stewardship, and increased regional awareness of the value of wildlife, particularly of charismatic endangered species like the jaguar. It also works to eliminate conflict between ranchers and wildlife, particularly mountain lions and jaguars. It has partnered with Naturalia (see below) to set up jaguar preserves in Mexico. The two organizations have a Memorandum of Agreement to cooperate in management, operation, and expansion of the existing reserve in northern Sonora, Mexico.

All funding received by the Northern Jaguar Project goes to support protection of habitat and wildlife in the Northern Jaguar Reserve and the surrounding area. The Project operates a small field station and research program on the reserve, in conjunction with Naturalia. Researchers are conducting studies related to large carnivores, using trip cameras and hair snares to gather data on population densities, movement, dispersal, diet, and habitat needs. Visiting researchers are conducting plant inventories and making preliminary lists of birds and insects. The Project's "jaguar guardian" program maintains a permanent presence on the reserve, to help ensure protection for all species.

Borderlands Jaguar Detection Project. As of May 2006, the Borderlands Jaguar Detection Project had documented 62 jaguar events inside the state of Arizona since its initiation in 2001 (McCain et al. 2006). This includes 42 photographs and 12 sets of tracks. Ten scat/fecal samples were collected (Haynes et al. 2005), but DNA analysis in 2006 did not confirm them as being of jaguar origin (M. Culver pers. comm.). The photo and track detections confirmed occasional presence of two adult male jaguars, and possibly a third unidentified individual, in southeastern/southcentral Arizona since 1996.

3.3 Conservation and Research Efforts in Mexico

On October 12-15, 2005, Mexico, under direction of CONANP (Comision Nacional de Areas Naturales Protegidas, the National Commission for Protected Natural Areas) sponsored the 21st Century Mexican jaguar symposium. CONANP recognizes the value of conservation strategies, known as PREPs, for diverse species and the need to identify threats to species and prioritize consensus actions, set specific dates, and establish clear goals, indicators of success, responsible parties, resources, and follow-up to implement actions for conservation. Direct actions would include protection, management, and restoration of the species and its habitat. Indirect actions would include information dissemination, integrating jaguar conservation into the existing fabric of local cultures, and administration, all in an Action Plan for jaguar conservation over a five-year period.

Jaguar conservation in Mexico was elevated to the highest level of government when the President of the Republic declared 2005 to be “The Year of the Jaguar.” Approximately 38,000 hectares of the Sierra de Vallejo in Nayarit were decreed as State Natural Protected Areas, in cooperation with Hojanay (a nongovernmental organization). Banamex and the Fideicomiso Fund for Natural Heritage in Mexico reached an agreement with the Ejido Ursilo Galvan (a local cooperative from the same mountain range) to set aside 1900 hectares as an Ejidal Sanctuary for the jaguar. Likewise, Mexico signed a brotherhood pact for protected areas with Belize and Guatemala to support a biological corridor in this critical area of “Jaguars without Borders” with Unity for Conservation (another nongovernmental organization). State-specific jaguar conservation strategies have been produced for Jalisco, Michoacán, and Oaxaca. In cooperation with PROFEPA (Procuraduría Federal de Protección al Ambiente, the Federal Ministry for Environmental Protection), communities and nongovernmental organizations have implemented community watch groups in 14 states. There are 25 watch groups, with more than 400 rural community members that protect areas to stop illegal hunting and change land use.

Naturalia is one of Mexico's most active and forward-looking conservation organizations. In 2003, *Naturalia* purchased a 10,000-acre ranch in northern Sonora that has become the core of a new jaguar reserve. The reserve is dedicated to protection of jaguars and all other wildlife species present, and to rehabilitation of habitat. It has a small research field station, one of a handful in Sonora. Staffing and operations at the field station are the responsibility of the Northern Jaguar Project. At the reserve, biologists are working on the first inventories of birds, mammals, butterflies, and plant species ever done in northern jaguar habitat. In 2006, *Naturalia* obtained a 3-year option to purchase a ranch bordering the 10,000 acres it has already purchased (D. Hadley pers. comm.).

Another trip camera project has been implemented in Sonora, south of the New Mexico border, with a goal to document jaguar presence in the area (C. Lopez-Gonzales pers. comm.).

4. Conservation Framework

4.1 Introduction

This Conservation Framework (Framework) has a Goal, Objectives and Conservation Actions necessary to achieve the Goal, and Administrative tasks required to implement the Framework. It is based on the Conservation Assessment and Strategy developed by Johnson and Van Pelt (1997) on behalf of AGFD and NMDGF. Its focus is on voluntary collaborative conservation, based on shared values and incentives rather than regulatory requirements. The Framework recognizes the importance of cooperation with and participation by government agencies, private individuals, and nongovernmental organizations. Any member of the public can assist with this effort by participating in JAGCT public meetings, and by providing comment on documents and proposed actions. JAGCT participants may be asked to serve on various work committees, as needs arise (e.g. review of materials).

Effective jaguar conservation under this Framework will necessarily depend on cooperation of federal, state, and private landowners. Thus, all participants must, from the beginning, be aware of the importance of full involvement of private landowners to the extent that they desire, and further recognize the importance of compatible rural livelihoods and activities, such as ranching and outdoor recreation (including hunting and wildlife watching), and voluntary participation by private landowners in habitat identification, enhancement, and protection.

4.2 Goal

Contribute to maintaining a viable northern jaguar population in the AZ-NM/Mexico borderlands.

4.3. Implementation of the Conservation Framework.

4.3.1 Memorandum of Agreement.

4.3.1.1 This Framework will be implemented through a 2006 Memorandum of Agreement (MOA) for jaguar conservation. Signatories to the MOA are limited to government agencies, but participation is open to all who wish to voluntarily cooperate in conserving the jaguar. Timelines for implementing Conservation Actions in the Framework will depend on funding and availability of personnel and other resources. Note: participation in developing and implementing the Framework is strictly voluntary.

4.3.1.2 JAGCT is not a regulatory entity. Thus, the jaguar's needs must be met in the context of a wide spectrum of other wildlife needs and a variety of uses of federal, state, and private lands. It follows, then, that this Framework must be implemented in complete recognition of those factors, and through close coordination with other planning and management efforts, including state, federal, and private efforts in ecosystem management, wildlife management, allotment management, etc. However,

responsibility for changing plans and taking actions in response to JAGCT rests with the appropriate lead agency.

4.3.1.3 Although this Framework applies to the full historical range of the northern jaguar population, conservation effort will be focused in a priority geographic area that includes Santa Cruz, southern Pima, southern Graham, southern Greenlee, and Cochise counties in Arizona and Hidalgo County in New Mexico. This restricted geographic approach will allow available resources to be focused in the area in which a substantive return is most likely. Expansion of the priority geographic area to include other parts of Arizona and/or New Mexico will be addressed as needed. Work in Mexico under this Framework is subject to invitation and permission from Mexico.

4.3.2 Operation of the Jaguar Conservation Team (JAGCT).

4.3.2.1 JAGCT will be composed of one representative from each signatory, and chaired by AGFD or NMDGF, per the MOA.

4.3.2.2 In accordance with their primary responsibilities for wildlife conservation, AGFD and NMDGF will be known as Lead Agencies within this Framework.

4.3.2.3 Other MOA signatories will be known as Cooperators within this Framework.

4.3.2.4 Interested private individuals and nongovernmental organizations will be encouraged to participate in JAGCT by attending its public meetings and by participating in voluntary, action-specific agreements to promote jaguar conservation and education activities. Information on JAGCT meetings, activities, and links to other relevant websites will be provided on AGFD's website and through AGFD's self-subscription electronic newsletter, *Endangered Species Updates*.

4.3.2.5 JAGCT will coordinate and direct activities under this Framework. It will also review any new information, outline management guidelines, research, and education needs, and identify known and potential funding sources for carrying out this work.

4.3.2.6 JAGCT will meet publicly at least once annually, and more often as deemed necessary by the Lead Agencies and Cooperators. Agendas for JAGCT public meetings will be available to the public at least 21 calendar-days in advance, via notice disseminated through the *Endangered Species Updates*.

4.3.2.7 JAGCT public meetings will be held in available venues in the emphasis area for this Framework, on a rotational basis between AZ and NM whenever possible. In the event that jaguars are found to occur in other areas, JAGCT public meeting locations will be re-set to ensure that each general area of occurrence has an equitable share of the meetings.

4.3.3 Operation of the Jaguar Scientific Advisory Group (JAGSAG).

4.3.3.1 JAGCT will provide a sound scientific basis for jaguar conservation and a forum for information exchange, by maintaining an independent JAGSAG to review appropriate aspects of its work, such as survey, monitoring, research, and management recommendations. JAGSAG meetings will be held as often as needed, and may be conducted through teleconference or email to facilitate participation.

4.3.3.2 In appointing JAGSAG members, JAGCT will give preference to individuals with extensive expertise in the areas needed for jaguar conservation.

4.3.3.3 The JAGCT Chair will make JAGSAG's recommendations and guidance to JAGCT available to the entire JAGCT and interested members of the public.

4.3.4 Conservation and Cooperation with Mexico

4.3.4.1 JAGCT will encourage participation by Mexico in JAGCT meetings, by soliciting cooperation from federal, state, and local agencies and organizations in Mexico that are involved in research on or conservation of the northern jaguar population. AGFD, NMDGF, and USFWS will ensure that coordination with Mexico occurs within the framework of the Trilateral Committee. The Trilateral is comprised of federal wildlife agencies from the United States, Mexico, and Canada. Other federal agencies, state agencies, nongovernmental organizations, and individuals participate on an invitation basis.

4.3.4.2 Through the Trilateral Committee, JAGCT will continue to encourage and support Mexico's efforts to determine the present distribution and status of jaguars and jaguar habitats in Mexico; identify areas important to natural movement of jaguars between Arizona, New Mexico, and Mexico; and develop a national conservation strategy for jaguars. JAGCT will also continue to work with Mexico toward integrating the emerging Mexico strategy and this Framework, and to make available to Mexico any relevant information from studies of the northern jaguar population.

4.3.5 Cooperation with the Native American Nations

4.3.5.1 JAGCT will encourage Native American Tribes within the emphasis area for this Framework in the United States to become signatories to the MOA. JAGCT will also provide technical support, when requested, to appropriate Native American Tribes to help determine present distribution and status of jaguars and to identify possible jaguar travel areas.

4.4 Objectives and Conservation Actions

Objectives to achieve the Goal of this plan are identified in bold in the following sections. Conservation actions identified to achieve specific objectives are listed in the subsections under each objective. Conservation actions are not priority-ranked. Note: On-the-ground activities pursuant to this Framework shall not occur on private lands without prior

permission from the landowner(s). Note: JAGCT has determined, in consultation with JAGSAG, that it will not support reintroduction of jaguars into AZ or NM, due to prohibitive costs and because it would likely be an unproductive approach to jaguar conservation at the northern edge of the species' range.

4.4.1 Identify habitat characteristics and document distribution and occurrence in the northern jaguar population.

4.4.1.1 JAGCT will continue to review relevant literature, advocate and provide support for jaguar studies, and incorporate findings from current jaguar studies to identify and continually refine understanding of habitat-use patterns, using appropriate field-tested methods.

4.4.1.2 AGFD and NMDGF will continue to document northern jaguar distribution and occurrence by developing and maintain a monitoring program to detect and gather occurrence, habitat use, and other information. The program will include a voluntary-participation survey of ranchers and other "back country" inhabitants and users to help determine current and recent occurrence of jaguars.

4.4.1.3 If a jaguar is found alive in Arizona and/or New Mexico, or along the International Border, AGFD, NMDGF, and USFWS will make a concerted effort to monitor its movements through the least intrusive but most effective means possible. AGFD and NMDGF will require via permit stipulations that any jaguar a signatory agency captures in a trap shall be reported to the appropriate state wildlife agency and USFWS before release, so they can decide whether to radio-collar and monitor it. However, if the trapped animal is judged by the person who first encounters it to be in danger of debilitating injury or death, it shall immediately be released and the appropriate state wildlife agency will, if feasible, coordinate subsequent monitoring and assessment of the trap location, with support from JAGCT.

4.4.1.4 AGFD and NMDGF will cooperate with other signatories to continue to coordinate and maintain a sighting report procedure and database for information about jaguar occurrence. The system will include detailed criteria by which to assign a credibility ranking, so confirmed records are the primary basis for JAGCT recommendations and actions. The criteria shall address such factors as type and quality of sighting (e.g. distinct tracks, clear and well focused photograph, detailed sight record), the observer's experience with jaguars and similar species, weather conditions at time of sighting, total time that the animal was under observation, etc.

4.4.1.5 As necessary, and in timely fashion, JAGCT will seek funding and other support from signatories, outside agencies, organizations, and individuals for the work referenced above. Occurrence information will be assigned standardized credibility rankings, and submitted to at least three experts in the field for evaluation as to accuracy and importance.

4.4.2 Identify and map habitat of the northern jaguar population, including key linkages from Mexico to the United States.

4.4.2.1 AGFD, NMDGF, USFWS, and other signatories will coordinate with partners in Mexico and the United States to identify and assess areas in which jaguars occur or might occur, as transients or otherwise. At a minimum, these assessments will consider the physical features important to jaguars for connectivity. Where possible, they will also characterize other potentially important aspects (e.g. prey base).

4.4.2.2 AGFD and NMDGF will maintain and revise as needed state-specific maps delineating land ownership patterns overlaid with jaguar distribution information, including points of known or reported occurrence, together with habitat types in which jaguars are known to occur or likely to occur. Private lands on such maps will not list or be described by individual property names or owners. These maps will be a primary basis for evaluating constraints to, and opportunities for enhancing jaguar presence within each state, i.e. they will help focus JAGCT efforts to ensure that jaguars are not killed unlawfully or unintentionally and that their ability to move freely across the landscape is not unnecessarily constrained.

4.4.3 Assess threats to the northern jaguar population and identify limiting factors.

4.4.3.1 JAGCT, in cooperation with partners in the United States and Mexico, will provide recommendations for assessing the benefits and negative impacts of current and planned actions on jaguars in the United States and Mexico.

4.4.3.2 JAGCT members will share information on any impact assessments they conduct regarding proposed actions where jaguars may occur, and provide those results to JAGCT for informational purposes and possible referencing in the JAGCT annual report. JAGCT members may request assistance from other members to assist with impact assessments, although assessments will typically be part of the agency's existing review and evaluation process for proposed actions (e.g. NEPA and ESA Section 7 compliance measures), where applicable.

4.4.4 Conserve northern jaguar population habitat, including key linkages between Mexico and the United States.

4.4.4.1 JAGCT will cooperate with Mexico to encourage land and resource managers to ensure that current and future needs for persistence and natural dispersal are appropriately addressed for the northern jaguar population.

4.4.4.2 JAGCT will cooperate with Mexico to develop recommendations or guidelines for habitat conservation and enhancement activities that are appropriate for each country and which contribute toward overall conservation of northern jaguars.

4.4.4.3 JAGCT will provide technical assistance and conservation recommendations to the Border Patrol and other federal agencies in the United States on issues that might constrain jaguar movement between the United States and Mexico (e.g. border

security actions, border infrastructure, and illegal immigration) or jaguar occurrence in the United States.

4.4.4.4 JAGCT will identify and monitor issues and concerns relevant to conservation of the northern jaguar population. A list of issues and concerns will be made available to the public on the JAGCT website.

4.4.4.5 JAGCT will identify and develop incentives for landowners to encourage presence of jaguars within the emphasis area, and encourage individual agencies within JAGCT to work with willing landowners to execute agreements to protect jaguar habitat, including movement corridors, through voluntary mechanisms including but not limited to easements.

4.4.4.6 Private property owner claims in the United States for compensation for livestock lost to jaguar depredation will be referred to the Malpai Borderlands Group (MBG) for payment from a fund established by MBG for that purpose. Payment will be based on compensation and jaguar kill identification guidelines approved by MBG. Updates to the guidelines will be provided to JAGCT as a courtesy, and to help JAGCT work with Mexican partners to determine if a similar program can be developed for Mexico.

4.4.4.7 JAGCT will conduct workshops to identify landowner, manager, and permittee concerns related to jaguar conservation and to develop possible solutions. Workshops will incorporate discussion of conservation biology, property rights, land-use philosophies, and other relevant topics. They will involve or be open to JAGCT members, agency decision-makers, and interested members of the public.

4.4.4.8 JAGCT will help implement conservation measures on private lands only in response to invitation from the appropriate landowner(s). Private property owners shall not involuntarily be subject to any such measures.

4.4.5 Promote Protection of Jaguars in the United States

4.4.5.1 Predator control activities by signatories will not be purposefully directed at jaguars. However, predator control activities are subject to a variety of federal and state laws, local ordinances, and oversight by various federal and state land management, wildlife management, and agricultural agencies or programs. Thus, any JAGCT discussions or recommendations regarding predator control will be carefully coordinated with the appropriate entities. Note: live-trapping for hazing purposes can be used when and if appropriate to avoid harm to a jaguar.

4.4.5.2 NMDGF will continue to work toward equalizing or increasing New Mexico's civil legal disincentives (fines) for unlawful take of jaguars, to make them commensurate with current federal fines.

4.4.5.3 AGFD and NMDGF will investigate proposing increased state criminal penalties (fines and prison terms) for unlawful take of jaguars, to make them commensurate with current federal penalties under ESA.

4.4.6 Conduct research to improve knowledge of jaguars, jaguar conservation, and detection and handling of jaguars

4.4.6.1 JAGCT will sponsor, conduct, and encourage others to conduct research to improve knowledge of jaguars and understanding of how to conserve them in a multiple-use private/public lands context. JAGSAG will be used to review and make recommendations on research concepts and proposals.

4.4.6.2 JAGCT will review, and revise as necessary, its procedures for handling jaguars that are captured alive.

4.4.6.3 JAGCT will evaluate the feasibility and utility of a Population and Habitat Viability Analysis/Assessment (PHVA) for the northern jaguar population. If a PHVA is found to be feasible, and useful, in forwarding conservation efforts, it will be conducted when and if sufficient data exist and funding is available.

4.4.7 Develop and implement information and education programs to promote conservation of jaguars and their habitat

4.4.7.0 JAGCT will develop publications and make them available to the public, including updating reports on jaguar status, distribution, occurrence, habitat, ecology, and conservation. Draft reports will be submitted to at least three qualified individuals in the appropriate field for review, and to the general public through JAGCT for comment. Final reports will be made available to the public.

4.4.7.1 JAGCT will review published information pertaining to jaguar conservation and inform the public about it.

4.4.7.2 JAGCT will promote public support of jaguar conservation by developing and distributing information and education materials (e.g. brochures, media kits, web pages). Outreach focal points will include wildlife viewers, hunters, ranchers, farmers, other private landowners, conservation groups, and local governments. All educational materials developed by or for JAGCT shall be reviewed by at least three professional educators with appropriate expertise, and/or a JAGCT Committee.

4.4.7.3 When practical, materials will be made available in Spanish as well as English.

4.4.7.4 Specific information and education actions

4.4.7.4.1 AGFD and NMDGF will promote their 24-hour "hot lines" (1-800 numbers) for reporting wildlife violations, and rewards for information that leads

to convictions. Private donations will be sought to supplement rewards offered by the state agencies for convictions in cases of unlawful take of jaguars.

4.4.7.4.2 JAGCT will develop and maintain a balanced, scripted presentation on jaguar conservation for general use. Any group that desires to participate in this or a similar JAGCT information or education effort, or to adapt these materials for its own use, whether or not at its own expense, must provide their materials for review by the JAGCT, and acknowledge in the final version of said materials whether or not the JAGCT endorsed the final product.

4.4.7.4.3 JAGCT will, at a minimum, produce and distribute jaguar conservation information through: annual hunting regulation publications, hunting license vendors, or other outlets; a fact sheet summarizing the status of the jaguar and its conservation needs, for dissemination through the internet or by other means; articles for agency and other magazines; and a segment for at least one Lead Agency or Cooperator television show.

4.4.8 Evaluate progress and accomplishments.

4.4.8.1 Each January-February, AGFD and NMDGF will jointly develop a written report on the previous year's effort to conserve the jaguar. The report will reference specific Objectives and Conservation Actions identified in the Framework, identify tasks that were planned for the previous year, and note whether and why the tasks were accomplished or not accomplished. JAGCT Cooperators and participants will be given at least one 30-day review opportunity. AGFD and NMDGF will then submit the report to USFWS, and make it available to all interested parties.

4.4.8.2 JAGCT will use adaptive management principles to evaluate this conservation effort, and make necessary changes, based on experience, outcomes, and changed circumstances.

Glossary

Conservation biology: the branch of biological sciences that deals with the effects of humans on the environment and with the conservation of biological diversity (variety of lifeforms). It uses principles and experiences from the biological sciences, natural resource management, and the social sciences, oftentimes including economics.

Habitat: the particular place or environment in which an organism (for example, an animal or plant) lives, or can usually or just sometimes be found. Examples: a species of bat might occupy a maternity roost in a cave but have its late summer roost (post breeding) in the attic of a building or an underpass on a roadway. Its winter roost might be a cave in a different (perhaps more southerly) country. In summer its foraging habitat might be pine forests in the United States, while in winter it might forage in elfin woodland in central Mexico. In short, a species' "habitat" can and often does vary seasonally, in different phases of the life cycle (juvenile, young adult, adult, senescent), in response to changing weather conditions, drought, prey abundance or shortage, or competition with or pressure from other animals. Some species have extremely narrow habitat preferences or tolerances (for example, some springsnails). Others have very, or relatively, broad habitat preferences or tolerances (for example, jaguars and humans). This is partly why it is so challenging for people to expect a specific, narrow definition of a species' habitat.

Historical range: where a species used to occur, long ago. Oftentimes the historical range is larger than the currently occupied range, perhaps (for example) because something caused the species' population to decline, or rendered the habitat in an area inhospitable.

Inhabit: to live somewhere, whether seasonally, year-round, at a stage of a life-cycle, etc.

Occupied range: the portion of a species' historical or recent range that it now inhabits. Occupied implies that a portion of the range is now unoccupied, perhaps (for example) because of population decline or habitat changes.

Occupied habitat: the habitats within an area that a species actually inhabits.

Population: a group of organisms of the same kind, usually the same species, inhabiting a given area.

Scientific method: the body of techniques for investigation of natural or other phenomena and acquisition of new knowledge of the natural world, as well as correction and integration of previous knowledge, typically based on observable, empirical, measurable evidence, and subject to the laws of reasoning. The scientific method generally involves observation, formulation of a hypothesis, experimentation (data gathering), and analysis and conclusion that validates or modifies the hypothesis.

Literature Cited
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